INSTALLING AND PROGRAMMING THE RADIO SYSTEMS ON AIRNET STATIONS

Purpose

This Meteorology and Air Quality Group (MAQ) procedure describes the assembly and programming of the radio-frequency systems installed on selected AIRNET stations.

Scope

This procedure applies to the individuals assigned to assemble, install, and program the radio-frequency systems on selected AIRNET stations.

In this procedure

This procedure addresses the following major topics:

Hazard Control Plan

The hazard evaluation associated with this work is documented in Attachment 1: Initial risk = **low**. Residual risk = **minimal**. Work permits required: **none**. First authorization review date is one year from group leader signature below; subsequent authorizations are on file in group office.

Signatures

Prepared by: Jake Martinez Jake Martinez, MAQ	Date: 5/24/04
Approved by: Craig A. Eberhart Craig Eberhart, Air Monitoring Project Leader	Date: 6/2/2004
Approved by: Terry Morgan Terry Morgan, QA Officer	Date: 6/2/04
Work authorized by: Jean M Dewart Jean Dewart, MAQ Group Leader	Date: 6/2/04

06/21/04

General information about this procedure

Attachments

This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	Hazard Control Plan	2
2	Example Program for CR10X Unit	2

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	11/4/99	New document.
1	6/16/04	Added safety information about safe distance from power lines.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- Technicians assigned to install the RF systems

Training method

The training method for this procedure is **on-the-job** training by a previously-trained individual and is documented in accordance with the procedure for training (MAQ-024).

Prerequisites

In addition to training to this procedure, the following training is also required prior to performing this procedure:

- MAQ-011, “Logbook Use and Control”
- Cardiopulmonary Resuscitation (CPR)

References

The following documents are referenced in this procedure:

- MAQ-011, “Logbook Use and Control”
- MAQ-024, “Personnel Training”
- Operator’s Manual for Campbell Scientific CR10X
- Operator’s Manual for Campbell Scientific PS12 power supply
- Operator’s Manual for Campbell Scientific RF95 RF Modem
- “Radiotelemetry Network Instruction Manual”

Installing an RF unit

System description

The radio frequency (RF) system used on the AIRNET stations is manufactured by Campbell Scientific, Inc. The base antenna is located on the top of the Cave and is connected to a model RF-95 radio base station unit which is in turn connected to a COM port on the base computer. Stations equipped for RF monitoring have a data collection unit, a radio, and antenna. A station may communicate directly with the base station if the signal strength allows it, or it may communicate via another station that acts as a repeater.

One station is connected to the base station via a phone line. This station uses the same internal components except for a DC-112 phone modem instead of a radio unit. The phone is used at this station because of the proximity of a sensitive radio telescope antenna. Because no new phone-based communications are planned, the installation of a phone system is not described in this procedure but is similar to that for the RF units.

Where RF units are used

The RF transmitters are installed on AIRNET stations that are considered critical, especially the "FFCA" stations that must meet completeness and runtime criteria. Other stations may have the RF systems installed as directed by the Environmental Measurements Project Leader.

Equipment and parts needed

To install a system, collect the following parts and equipment:

- Campbell Scientific weathertight box with mounting hardware
- CR10X data recorder
- PS 12 power supply unit with battery
- RF95 RF modem
- Johnson Design radio Model DL3420 or DL3422
- Omni-directional or directional antenna, with mounting hardware
- Transformer (110V to 18V, 1.11A)
- Relay for indicating power loss, mounting socket
- Mounting brackets, screws, and hardware for attaching box to station legs

Warning

Be aware of power lines in the vicinity of the installation site. Do not allow any metal object, especially antenna poles, to come within 13 feet of a power line.

Installing an RF unit, continued

Steps to install an RF system

To install an RF system in an AIRNET station, perform the following steps:

Step	Action
1	Mount the equipment on the board inside the box.
2	Remove the lid on the RF modem and set the DIP switches to the ID number of the station. The ID number is the same as the AIRNET station number. Refer to the table in the "Radiotelemetry Network Instruction Manual" for the settings.
3	Install the battery into the PS12 box. Plug into INT terminal. Leave the power switch off.
4	Connect the two power leads from the PS12 to the + and – terminals in the CR10X.
5	Hook up transformer (110V to 18V, 1.11A) to charging terminals on PS12. Run cord out bottom of housing to inside of AIRNET station and plug the transformer into the outlet inside the station.
6	Connect the power leads from the radio to the power terminals inside the PS12 box.
7	Install the omni-directional or the unidirectional antenna on the side of the station. Run the antenna cable through the hole in the bottom of the Campbell box and connect the end to the radio unit.
8	Connect the communication cable (tape style) from the CR10X to the modem.
9	Connect the radio communication cable (tape style) from the modem to the RF95 radio.
10	Turn on the power switch on the PS12 and observe the red light on the modem: it should blink twice and go out. This indicates everything is connected properly.
11	Put the lids back on the PS12 unit and the modem.
12	Use the "goop" supplied with the Campbell box to seal the opening in the bottom of the box (around the transformer power cord and the antenna lead).
13	Close up the box and return to the Cave to initiate radio communications and program the unit.

Programming the CR10X and RF units

Programming the station

After installing a RF system, it needs to be programmed. This is done with the computer program on the base computer and then transmitted to the station via radio.

Steps to set up primary file

To create the primary file for a new AIRNET station, perform the following steps:

Step	Action
1	Run the program "PC208W" on the base computer.
2	Click the Program button, then File, New.
3	Copy another program for another station into this file. See the typical example program in Attachment 2. Ensure the station ID is changed throughout as necessary. Give the file a name that is composed of the station ID.
4	Compile the program.
5	Click the Setup button then select the Hardware tab. Ensure the following options are set: • Dialed Using RF95 Path: set to "U" if it's possible to establish direct, high quality, communication with the station from the base. If the communication quality is poor, enter "A." If communication is still not possible, set a repeater by entering "A61 60F" (this sets station 61 as a repeater to station 60).
6	Click the Data collection tab and ensure the following option boxes are checked: • Data logged since last call • Append to end of file. • ASCII, comma separated Turn on check box "Collect Final Storage Area 1" Enter "0" in "Arrays to collect on 1st call"
7	Click on Schedule tab and ensure the following parameters are entered: • Calling interval: 01 00:00:00 • Next time to call: set to next available time interval so each station is called sequentially at 4-minute intervals. • Primary retry interval: 02:00 • Tries: 2 Turn on check box "Schedule on"
8	Click on Save Edits button before closing.

Programming the CR10X and RF units, continued

Steps to set up shadow file

To create the "shadow file" for a new AIRNET station, perform the following steps:

Step	Action
1	Perform steps 1 – 4 above to create a file, but name it with the station ID and the suffix "_s".
2	Click the Setup button then select the Hardware tab. Ensure the following options are set: • Dialed Using RF95 Path: enter "1" • Security code: enter "0" • Call back ID number: enter the station number
3	Click the Data collection tab and ensure the following option boxes are checked: • Most recently logged arrays • Append to end of file. • ASCII, comma separated Turn on check box "Collect Final Storage Area 1" Enter "24" in "Arrays to collect on 1st call"
4	Click on Schedule tab and ensure the following parameters are entered: • After call do: enter "cd_notif" Turn off check box "Schedule on" (All other parameters have no affect.)
5	Click on Save Edits button before closing.

Connect to the new station

After creating the files in the steps above, connect to the station by clicking the button Connect. Select the station number from the list and click Connect. If the program indicates a connection is established, click the Send button to send the program to the station.

Checking call back files

If the station has called back because of power loss, low battery voltage, or other problem, the program will create a "shadow file" (with "_s" suffix in file name) for that call. Click the View button to look for the shadow files of the most recent dates and open them to see why the station has called.

Programming the CR10X and RF units, continued

Record work performed

Record in the AIRNET field logbook the date of the installation of the RF system, the station number, notes on any problems encountered, and any other work performed. Follow the requirements in MAQ-011 when making logbook entries.

Records resulting from this procedure

Records

The following records are generated as a result of this procedure and will be submitted according to MAQ-011:

- Entries in the logbook to document the work performed

HAZARD CONTROL PLAN

1. The work to be performed is described in this procedure:
"Installing and Programming the Radio Systems On AIRNET Stations"

2. Describe potential hazards associated with the work (use continuation page if needed).

Electrical shock.
Pinched fingers or other minor injuries from use of hand tools.
Electrocution from contacting overhead power lines.

3. For each hazard, list the likelihood and severity, and the resulting initial risk level (before any work controls are applied, as determined according to LIR300-00-01, section 7.2)

Electrical shock – battery in unit is a small 12 volt battery, and standard small transformer is plugged into standard 110V outlet: improbable / moderate = low
Use of hand tools (screw drivers, wrenches, knives, pliers & wire cutters, etc.) – occasional / negligible = minimal.
Electrocution – catastrophic / remote = low

Overall *initial* risk: ☐ Minimal ☒ Low ☐ Medium ☐ High

4. Applicable Laboratory, facility, or activity operational requirements directly related to the work:
☒ None ☐ List: Work Permits required? ☒ No ☐ List:

HAZARD CONTROL PLAN, continued

5. Describe how the hazards listed above will be mitigated (e.g., safety equipment, administrative controls, etc.):

Electrical shock – battery in unit is small 12 volt, so potential for shock is minimal. Steps call for connecting battery only after all other connections made. Transformer is plugged into GFI outlet and no exposed connectors are involved.
Pinched fingers or other minor injuries from use of hand tools – use common sense and use proper tool for the job.
Electrocution – maintain at least 13 feet distance between the closest end of a metal antenna and a power line (from "General Requirements for Electrical Work Practices", 2000 edition).

6. Knowledge, skills, abilities, and training necessary to safely perform this work (check one or both):
   - ☒ Group-level orientation (per MAQ-032) and training to this procedure.
   - ☐ Other → See training prerequisites on procedure page 3. Any additional describe here:

7. Any wastes and/or residual materials? (check one) ☒ None ☐ List:

8. Considering the administrative and engineering controls to be used, the *residual* risk level (as determined according to LIR300-00-01, section 7.3.3) is (check one):
   ☒ Minimal ☐ Low ☐ Medium (requires approval by Division Director)

9. Emergency actions to take in event of control failures or abnormal operation (check one):
   ☒ None ☐ List:

Signature of preparer of this HCP: This HCP was prepared by a knowledgeable individual and reviewed in accordance with requirements in LIR 300-00-01 and LIR 300-00-02.

Preparer(s) signature(s)	Name(s) (print) /Position	Date

Signature by group leader on procedure title page signifies authorization to perform work for personnel properly trained to this procedure. This authorization will be renewed annually and documented in MAQ records. Controlled copies are considered authorized. Work will be performed to controlled copies only. This plan and procedure will be revised according to MAQ-022 and distributed according to MAQ-030.

EXAMPLE PROGRAM FOR CR10X UNIT

```
;{CR10X}
;
*Table 1 Program
  01: 10       Execution Interval (seconds)

1:  Batt Voltage (P10)
 1: 1        Loc [ batvolt   ]

2:  If Flag/Port (P91)
 1: 28       Do if Flag 8 is Low
 2: 30       Then Do

3:  Do (P86)
 1: 11       Set Flag 1 High

4:  Do (P86)
 1: 18       Set Flag 8 High

5:  End (P95)

6:  If Flag/Port (P91)
 1: 41       Do if Port 1 is High
 2: 21       Set Flag 1 Low

7:  IF (X<=>F) (P89)
 1: 6        X Loc [ _________ ]
 2: 4        <
 3: 12.5     F
 4: 21       Set Flag 1 Low

8:  Initiate Telecommunications (P97)
 1: 2        RF Modem/9600 Baud
 2: 1        Disabled when User Flag 1 is High
 3: 180      Seconds Call Time Limit
 4: 600      Seconds Before Fast Retry
 5: 3        Fast Retries
 6: 0        Minutes before Slow Retry
 7: 5        Failures Loc [ _________ ]
 8: 091      Data Logger ID

9:  Extended Parameters (P63)
 1: 2        Option
 2: 5        Option
 3: 4        Option
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 4: 70       Option
 5: 13       Option
 6: 0        Option
 7: 0        Option
 8: 0        Option

10:  If time is (P92)
 1: 0        Minutes (Seconds --) into a
 2: 60       Interval (same units as above)
 3: 10       Set Output Flag High (Flag 0)

11:  Set Active Storage Area (P80)
 1: 1        Final Storage Area 1
 2: 091      Array ID

12:  Real Time (P77)
 1: 1120     (Same as 1220) Y,D,Hr/Mn

13:  Average (P71)
 1: 1        Reps
 2: 1        Loc [ batvolt    ]

*Table 2 Program
  02: 0.0000    Execution Interval (seconds)

*Table 3 Subroutines

End Program
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